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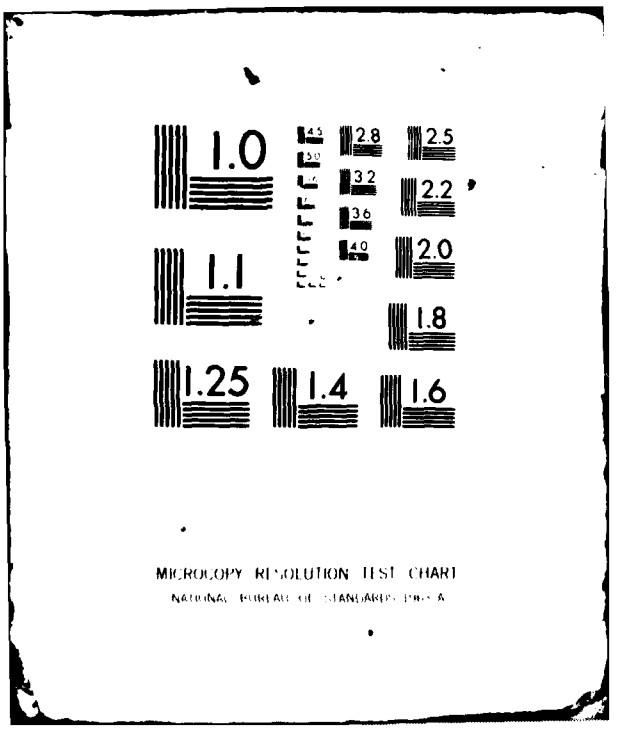
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Structures Technical Memorandum 325

WEATHERING TESTS ON PROTECTIVE HELMETS APPROVED TO AUSTRALIAN STANDARD AS 1698 (FOR VEHICLE USERS). INTERIM REPORT NO. 3

S.R. SARSAILHE

Approved for Public Release.

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SUMMARY

This interim report describes the results of impact tests on helmets after eleven months exposure to the weather. No deterioration in performance was detected. The investigation is supported by the Office of Road Safety and is planned to continue with further tests at eighteen months, two years and three years after commencement of the exposure.

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16. ABSTRACT:

This interim report describes the results of impact tests on helmets after eleven months exposure to the weather. No deterioration in performance was detected. The tests were part of an investigation which is planned to continue for three years with further tests to be carried out eighteen months, two years and three years after commencement of the exposure.

The work is sponsored by the Office of Road Safety, Department of Transport.

CONTENTS

1. INTRODUCTION

This memorandum describes the results of impact tests on helmets, some of which had been exposed to the weather for eleven months and others which had been kept in storage. Exposed and stored helmets were matched.

All the helmets have been approved to Australian Standard 1698 (1974).

The methodology and results of pre-exposure tests were described in the first interim report (Sarrailhe & Thomas 1979) and results of tests after seven months of exposure were given in the second interim report (Sarrailhe 1980).

In these tests it was found that all the helmets with shells constructed from glass fibre reinforced plastic (GRP) prevented the point of the striker from penetrating to contact the surface of the headform but the depth of penetration varied considerably. Small penetration signifies a reserve of strength beyond the requirements of the standard but could also imply that an excessive impact force could be transmitted to the head because deflection of the shell can 'cushion' the impact. The impact force was assessed in the tests described below by measuring the deceleration of the striker. The forces with all of the helmets were found to be much less than those implied to be acceptable in other parts of the standard specification.

The work is part of a three year program supported by the Office of Road Safety, Commonwealth Department of Transport.

2. THE HELMETS

Six specimens of each of seven models of helmet were tested. Details have been given in the previous reports but the leading particulars are summarized in Table 1.

3. THE EXPOSURE PERIOD

The three Shoei helmets were first exposed in July 1979, the other helmets were first exposed one month earlier. All helmets were removed for testing for three days in January 1980 and were again removed for the tests described below from the 19th of May 1980 until the 23rd of May 1980.

4. VISUAL INSPECTION

Most of the helmets had lost their gloss and some of the colours had faded. The appearance of the G.R.P. helmets had deteriorated more than the polycarbonate helmets but the appearance could be improved by cleaning with soap and water and polishing with a clean cloth.

5. TEST PROCEDURE

The helmets were impacted by a 3 kg pointed striker (as detailed in AS 1698) on the right side, approximately perpendicular to the surface and 40° from the vertical axis. This level is denoted '-40' and is shown by the upper impact marks on Figs 1a and b. The exposed helmets were tested first.

The impact deceleration was measured by a Kistler 815 quartz accelerometer and Kistler 583 signal conditioner. The deceleration traces were displayed on a storage oscilloscope and photographed. Although indicating the magnitude of the deceleration the traces in earlier tests were blurred by high frequency vibration and in later tests on the 'control' (or stored) helmets a $2kH_z$ low pass filter was used and this gave a clear trace.

6. RESULTS

All the helmets prevented the point of the striker from contacting the headform in all the tests. With each type of helmet the indentations in exposed and stored helmets were similar. No deterioration in performance could be detected when the results of tests on exposed and unexposed helmets were compared.

The impact decelerations for the helmets were all within the range 140 to 200g. The values for each helmet are listed in Table 2. Maximum and minimum values are given for the two impacts on each of the pair of 'control' helmets but this refinement was not possible with the 'unfiltered' records from the 'exposed' helmets and a mean value is given. Comparison of 'filtered' traces for the control helmets and the 'unfiltered' traces from the exposed helmets showed' that the basic decelerations were similar. Fig. 2 shows typical results. Among the G.R.P. helmets the Arai 75 gave the smallest indentation, Fig. 1a, and the highest deceleration, Fig. 3, whilst the Bell gave the largest indentation, Fig. 1b, and lowest deceleration, Fig. 3. Impact deceleration with the polycarbonate shells was between 120 and 140g and an example is the Eldorado as shown in Fig. 3, the indentations remaining after the impacts were small but the material is resilient and the deflections during the impact would have been greater. As no deterioration was detected the 'reference' helmets were not tested.

7. DISCUSSION ON IMPACT FORCES

The greatest impact deceleration was 200g. This corresponds to a force of 6kN on the striker and as this value was developed late in the pulse it also corresponds to the force transmitted to the headform. This is only 30% of the value implied to be acceptable in the 'Impact Energy Attenuation' test which specifies a maximum deceleration of 400g on a 5 kg headform. It is therefore considered that for

maximum overall safety the shell should provide the greatest practicable resistance to penetration and the attenuation of the impact force should be provided by the energy absorbing lining and shell deflection without breakthrough.

8. CONCLUSION

Exposure to the weather for a period of eleven months did not cause any detectable change in the impact performance of any of the helmets.

9. ACCIDENTAL CONTAMINATION OF SOME HELMETS

While the 'exposed' helmets were being arranged for testing a nearby test rig was sprayed with WD40, a proprietory dewatering and lubricating fluid, from an aerosol pack. Some of the mist settled on some of the helmets and remained until it was discovered next morning. All the helmets were then cleaned with soap and water. The helmets most effected were Centurion 150 specimens E (heavy film) and B (slight film), Arai RM6, B.D. and E (all slight film) and Arai S75, B and E (slight film).

No film was visible on any of the other helmets but the specimens of helmets with polycarbonate helmets which were originally used for the impact survey (specimens A), and which were away from the contaminated area, were added to the exposed set to act as additional references.

REFERENCES

Sarrailhe, S.R. and Thomas, G.A. (1979). Weathering Tests on Protective Helmets Approved to Australian Standard AS 1698 (for Vehicle Users). Interim Report No. 1. Aeronautical Research Laboratories, Melbourne, November 1979.

Sarrailhe, S.R. (1980). Weathering Tests on Protective Helmets Approved to Australian Standard AS 1698 (for Vehicle Users). Interim Report No. 2. Aeronautical Research Laboratories, Melbourne, 1980.

Standards Association of Australia (1974). 'Protective Helmets for Vehicle Users'. Australian Standard AS 1698 - 1974. Standards Association of Australia. Sydney.

TABLE 1

HELMET WEATHERING TRIALS

HELMET DETAILS

SUMMARY ON HELMET DATA

HELMET	Colour	Production Date	Shell-Standard	Size	Length mm	Width mm	Mass grams	Circumference mm
ARAI	White	July '78	G.R.P.	Small	270	230	1190	790
	Yellow			Medium	275	230	1200	808
RM6	Red	Dec. '78	Z90.1 1971	Large	275	230	1200	808
ARAI	White	Aug. '77	G.R.P.	Small	275	232	1244	805
	Yellow			Medium	283	238	1291	825
S75	Orange	Dec. '78	Snell 75	Large	283	238	1320	825
BELL	White		G.R.P.	Small	269	222	1230	775
Super	Orange	-		Large	291	239	1362	835
Magnum	Grey		Snell 70					
CENTURION			Pc	3			1117	
150	Blue	Feb. '77 (all)	-	4	275	234	1140	803
ELDORADO	Yellow	May '77	Pc	Small			1237	
MH1	White	Dec. '77	-	Medium	280	236	1284	820
STADIUM	Yellow	Nov. '76	Pc	3			1005	
9	White	Jan. '77	-	4	265	229	1020	780
SHOEI	Blue	Dec. '77	G.R.P. +	Medium	282	230	1100	812
ZV	Maroon	Jan. '78	Aromatic Polymide Snell 75	Large	287	240	1150	836

Remarks:

G.R.P. - Glass Reinforced Plastic
Pc - Polycarbonate
Standard shown is additional to AS 1698

TABLE 2

MAXIMUM IMPACT ACCELERATION OF STRIKER AFTER A FALL OF 3 m.

Helmet type	Impact acceleration 'g'		Helmet mass range grams
	Exposed[1] specimens D and E	Stored[2] specimens F and G	
ARAI RM6	160	160 170	1190-1200
ARAI S75	160	150 200	1244-1320
BELL SM	140	140 160	1230-1362
CENTURION 150	150	150 150	1117-1140
ELDORADO MH1	140	140 150	1237-1284
STADIUM 9	140	140 150	1005-1020
SHOEI 2V	150	150 150	1100-1150

Notes: 1 Average acceleration peak, approximate only because of 'hash' on trace.

2 Acceleration range for the four test impacts.

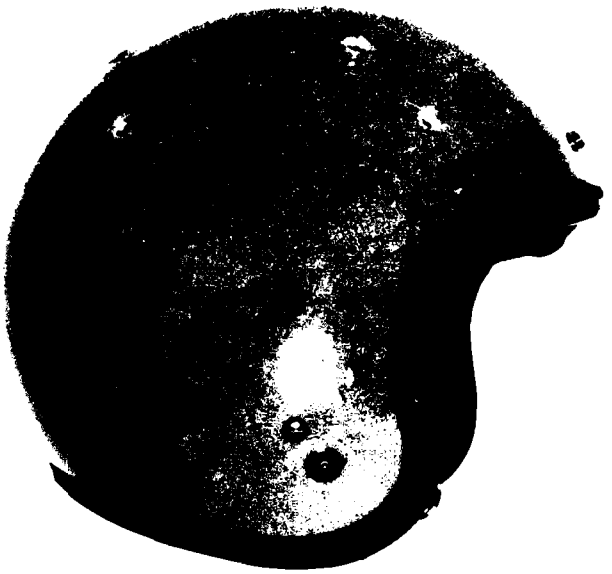

Fig.1(a) Arai S75

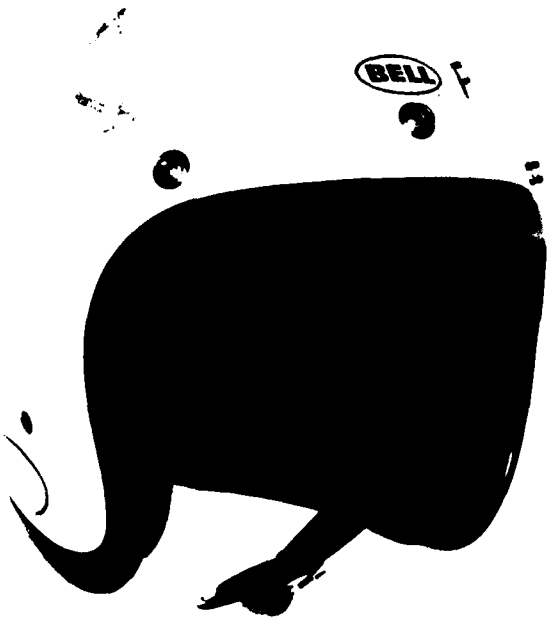

Fig.1(b) Bell Super Magnum

FIG.1(a&b) LOCATIONS OF IMPACTS SHOWN BY UPPER INDENTATIONS

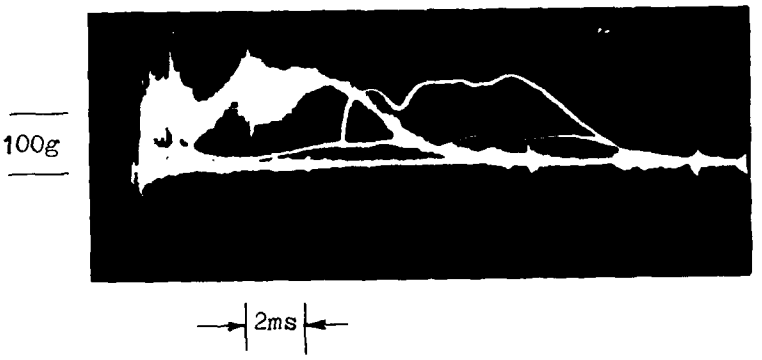

FIG.2 UNFILTERED AND FILTERED DECELERATION TRACES.
(Helmet Shoei ZV, specimen E)

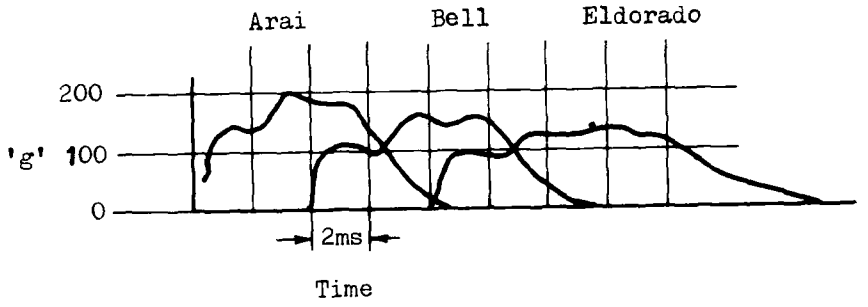

FIG.3 COMPARISON OF TYPICAL TRACES.
(Arai S75, Bell Super Magnum, and Eldorado)

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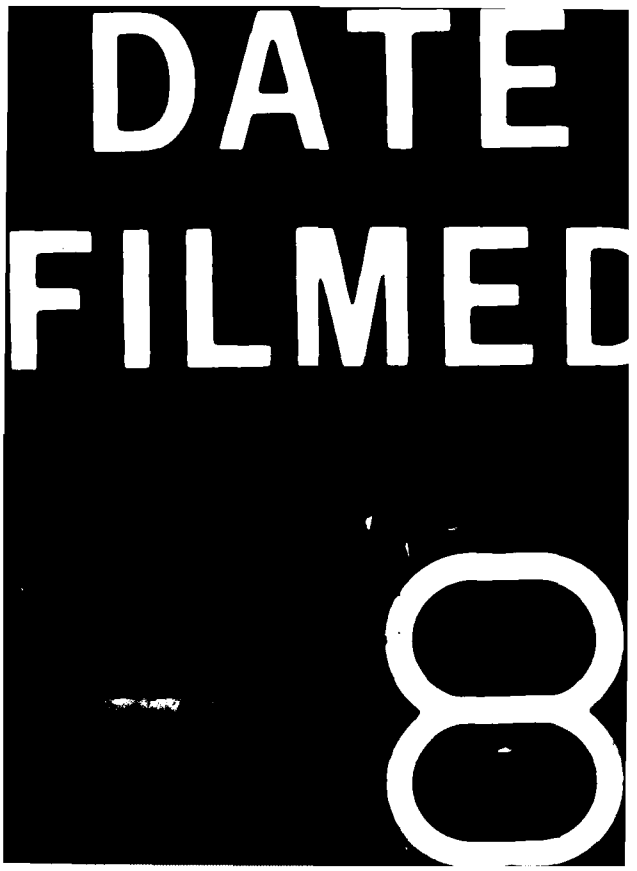
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